

## Entry Trajectory and Atmosphere Reconstruction Methodologies

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The next opportunity for surface exploration on Mars will occur in early 2004. The Mars Exploration Rover (MER) mission will send two landers to the surface of Mars, arriving in January 2004. The two missions were launched on June 10 and June 29, 2003, respectively. Each lander will carry a rover which will explore the surface of Mars making in-situ measurements. However, unlike the Mars Pathfinder mission's Sojourner rover, these rovers are larger and more sophisticated, and will be able to cover greater distances. Both landers will deliver the rovers to the surface utilizing the same entry, descent, and landing scenario that was developed and successfully demonstrated by the Mars Pathfinder mission on July 4, 1997. The capsule will decelerate with the aid of an aeroshell, a supersonic parachute, retro-rockets, and air bags for safely landing on the surface (see Fig. 1).

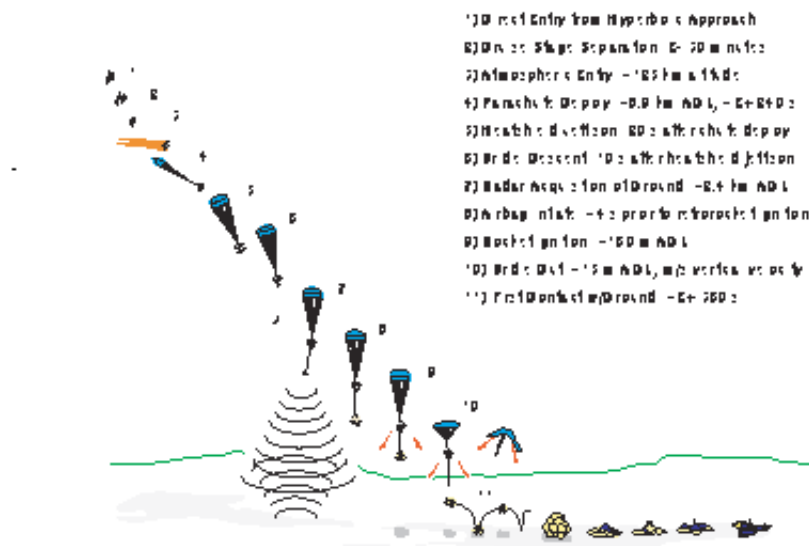


Figure 1. MER entry, descent, and landing sequence.

This paper will describe the approach that will be utilized for the MER descent trajectory and atmosphere reconstruction from hypersonic flight through landing. Multiple methodologies for the flight reconstruction will be applied from simple parameter identification methods through a statistical Kalman filter approach. Various reconstruction methods are employed to gain confidence in the overall reconstruction predictions along with an error assessment.

During the hypersonic phase of descent, three-axes accelerometer and gyro data will be acquired. This data set will be used in the reconstruction effort by the various methods. During the parachute phase, a redundant altimeter data will supplement the accelerometer and gyro data. Key parameters of interest from the reconstruction effort are the times and conditions at major descent events (e.g., parachute deployment, retro-rocket firing, landing position, etc.). However, a complete time history of the position, velocity, and entry attitude will be produced. In addition, the capsule aerodynamics and parachute loads will be determined for comparison to pre-flight predictions along with refinements in atmosphere model parameters. The final

paper will describe in detail the reconstruction methodology taken, and sample results will be generated using simulated sensor data from current MER entry simulations.